RELATIVITY AND QUANTUM MECHANICS — CONFLICT OR PEACEFUL CO-EXISTENCE

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Nonlocality in quantum mechanics provides a prima facie conflict with the foundations of special relativity which is usually taken to forbid causal processes operating outside the light cone. This question is discussed in the context of stochastic hidden-variable ~~theories~~ interpretations. The following criterion for a stochastic causal relation is introduced: Physical magnitudes $\underline{a}$ and $\underline{b}$ pertaining to two separated systems $\underline{A}$ and $\underline{B}$ exhibit a stochastic causal connection ~~if and~~ only if there exists a class of disturbances acting on $\underline{B}$, such that ~~a screen~~ a screen off $\underline{a}$ from those disturbances. This criterion is examined for the correlations contained in the singlet state of two spin-½ particles, where $\underline{a}$ denotes the spin-projection of particle $\underline{A}$ parallel to the direction $\hat{a}$ and $\underline{b}$ denotes the spin-projection of particle $\underline{B}$ parallel to the direction $\hat{b}$. The following results are obtained: (1) $\mathrm{Prob}(a=1)$ is unaffected by any [illegible] on the $\underline{B}$ particle $\underline{B}$. The [illegible]

of proof employed can easily be generalized to give a formal proof of the general result.

(2) ~~Prob(a=1|b=1)~~ For any given dynamics of particle B there always exist directions $\hat{d}$ and $\hat{b}$ such that $\mathrm{Prob}(\underline{a}=1|\underline{b}=1)$ is not invariant under the perturbation.

It is argued that this lack of robustness in the conditional probability shows that the correlation between $\underline{a}$ and $\underline{b}$ cannot be regarded as a causal one. This points the way to peaceful coexistence between quantum-mechanical nonlocality and special relativity.